# THE KANSAS UNIVERSITY SCIENCE BULLETIN.

Vol. V, No. 14—March, 1910.

(Whole Series, Vol. XV, No. 14.)

---

CONTENTS:

AN ARMORED DINOSAUR FROM THE UPPER CRETACEOUS OF WYOMING,
*Roy L. Moodie.*

---

PUBLISHED BY THE UNIVERSITY,

LAWRENCE, KAN.

October, 1911.

---

Entered at the post-office in Lawrence as second-class matter.

3310

# THE KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. V, No. 14 ] MARCH, 1910. [WHOLE SERIES VOL. XV, No 14

## AN ARMORED DINOSAUR FROM THE CRETACEOUS OF WYOMING.

BY ROY L. MOODIE.

(Contribution from the Zoölogical Laboratory, No. 190.)

Plates LV to LIX, and one text figure.

IN *Science* for October 20, 1905, Dr. S. W. Williston (*1*) published a brief account of a remarkable armored dinosaur from the upper Cretaceous of Wyoming. He likewise gave a short sketch of the horizon from which the specimen was obtained, naming the horizon Hailey shales, and suggesting the name *Stegopelta landerensis* for the dinosaur.

During the summer of 1906, while searching these beds for plesiosaur remains for the Carnegie Museum (*2*) the writer followed the horizon eastward and northward to the southern end of the Big Horn mountains. The beds increase in thickness towards the east and the lithological character becomes different, changing from a soft fine shale in the west to a hard sandy rock in the Big Horn region. The Hailey shales lie just above and comformable on the Mowry beds, which Darton (*3*) describes as follows:

"The stratigraphic succession of the formation [Colorado] is uniform throughout. The lowest beds are several hundred feet of dark-colored shale, usually containing toward the base a deposit of sandstone from 2 to 20 feet thick. This is capped by the Mowry beds, consisting of from 100 to 150 feet of hard shales and thin-bedded, fine-grained sandstone of a dark gray color, which on exposure weathers to a characteristic light gray. These rocks are especially characterized by large numbers of fish scales in nearly every bed. They are often so

abundant as to number from five to ten on a surface of six inches square. Owing to their hardness the beds give rise to round-topped ridges of considerable prominence."

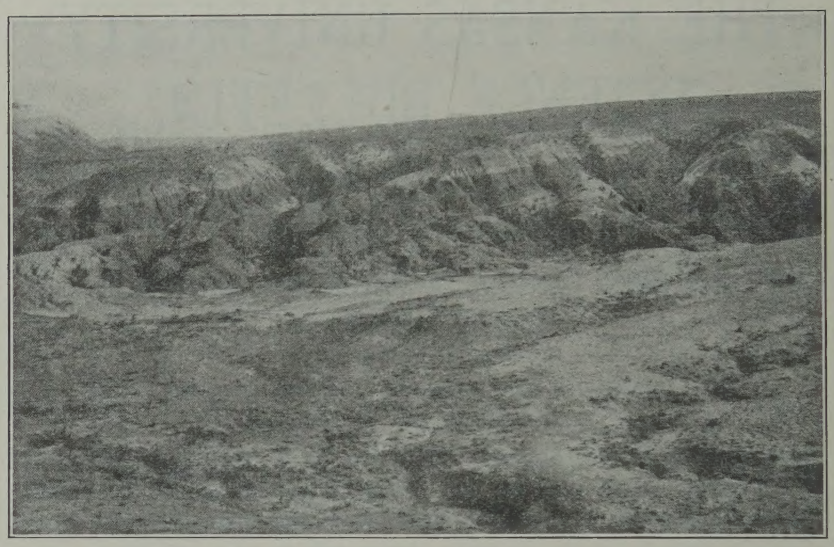

FIG. 1. A typical exposure of the Hailey shales on Connant creek, Wyoming. The Mowry beds may be seen on the left in the background.

In those parts of Wyoming where I worked, the Mowry beds stand out as prominent ridges of hard whitish shales which can be readily recognized from a long distance, and on that account serve as excellent landmarks for the identification of a region where the Hailey shales may occur. In thickness the Hailey shales vary from a few feet north of Lander, Wyo., to something over 200 feet in the Big Horn region. "Near Soap Creek the dark shales overlying the Mowry beds are about 200 feet thick," etc. (*6*). In most of their extent the Hailey beds have numerous brown sandy clay concretions which very often contain vertebrate remains. These concretions vary in size from a few inches to many feet in diameter. In the Big Horn region the concretions are stratified into distinct layers, but such is not the case in other places where the horizon was examined.

So far as is at present known the Hailey shales outcrop along the eastern flank of the Wind River mountains, in the Shoshone anticline; in the anticline along Beaver creek near Hailey, Wyo., the type locality; in an anticline north and west of the

Granite mountains, on Connant creek; in a small anticline west of the Rattlesnake mountains; along the northern and eastern flanks of the Rattlesnake mountains. There are extensive exposures on the eastern slope of the Big Horns, and I do not doubt that they occur also to the west of these mountains. In text-figure 1 is given a view of a typical exposure of the Hailey shales, on Connant creek, north of the Granite mountains, Wyoming. On the left of the photograph the Mowry beds stand out in the characteristic ridge.

The vertebrate fauna of the Hailey shales still remains to be accurately determined, but so far as known it is represented by large and small fishes, amphicœlian crocodiles with hollow limb bones, turtles with completely ossified carapaces and plastra like *Toxochelys* and plesiosaurs of two types. The remains of plesiosaurs are in places exceedingly abundant, evidences of no less than fifty-five individuals having been discovered during one summer. Occurring in these deposits, also, have been discovered the remains of three dinosaurs. The remains described below represent one of these animals. The other two are known in one case from a single worn dorsal vertebra found in one of the massive shell-concretions consisting of myriads of gastropod and lamellibranch shells together with plesiosaur teeth and vertebræ, about ten miles north of where the *Stegopelta* remains were exhumed; and in the other case from three caudal vertebræ discovered in the same beds nearly a hundred miles to the east, near the western base of the Rattlesnake mountains.

The *Stegopelta* remains herein described were once encased in one of the brown sandy clay concretions so abundant in this formation, but many years ago it was exposed and by the weathering processes of a long space of time had become reduced to hundreds of fragments. These fragments had washed and rolled down the slope and had been trodden in the mud by cattle so that when first discovered it was discarded as a worthless plesiosaur specimen. When Doctor Williston, however, in cleaning up some of the fragments came across some typical stegosaurian dinosaur teeth, the whole aspect of the matter was changed and every fragment was carefully collected. As boxed the specimen weighed only 450 pounds, of which about two-thirds was bone. It has been a long and tedious task to fit together the scattered and disassociated fragments, but through the combined efforts of Doctor Willis-

ton and myself a number of elements of the skeleton have been reconstructed.

The specimen as it now stands consists of the following parts: Fragments of the upper and lower jaws with a dozen or more teeth, most of which are fragmentary; seven fragmentary dorsal vertebræ; portions of the sacrum; two caudal vertebræ; many fragments of the ribs; a complete ulna belonging to the left side; portions of the right ulna; portions of the radii; the left ilium nearly entire; a part of the right ilium, showing the acetabulum; the right pubis nearly entire; a portion of the left pubis; the lower portion of the right tibia; the upper and lower ends of the right fibula; many large fragments of the metatarsals; nearly a hundred small bony scutes; several large bony plates, girdles and bony spines representing various portions of the dermal armor; together with a great quantity of waterworn fragments which it is impossible to determine.

The remains described as *Stegopelta landerensis* indicate a stegosaurian dinosaur about two-thirds the size of *Stegosaurus ungulatus* Marsh. The head was small, as is indicated by the size of the teeth. The fore limbs were not relatively so large as in *Stegosaurus*. The entire pelvic region was covered with a dorsal shield of rather thick, scrobiculate plates with elevated centers which are asuturally united over the pelvis. On each plate there is found, either on one side or in the central eminence, a pit, which possibly supported a more or less elongate horny spine. Anterior to the pelvic shield there were many dermal plates and scutes of various sizes scattered over the dorsal region of the body. The anterior portion of the animal appears not to have been armed. Back of the pelvis there were massive dermal plates, huge bony spines and a bony girdle probably encircling the tail in some such manner as in the glyptodonts. The neural spines of the caudal vertebræ were probably each surmounted by an elongate bony plate which quite possibly bore a horny excrescence of some kind. While closely similar in many respects to *Polacanthus*, *Stegopelta* shows wide structural differences from that form, although it must have had much the same appearance as Nopsca (*5*) has figured in *Polacanthus*. The present dinosaur, in life, may have stood nearly seven feet high at the hips and attained a length of sixteen to eighteen feet. Armed as it was with horns,

spines and excrescences it must have been a bizarre creature, even in those Cretaceous days.

The teeth (plate LVI, figs. 4 and 5) of *Stegopelta* are typically stegosaurian. There are a dozen of them in more or less perfect state of preservation. They are all of practically the same size and character, showing but little variation among themselves. The crowns of the teeth, which measure 7 mm. in breadth, are subcompressed and narrowly palmate with eight radiating costæ, all of which end at the tip in sharp points. The roots of the teeth measure 15 mm. from the base of the crown to the tip of the fang. In point of size and number of costæ the present teeth are so closely similar to those described by Leidy (*5*) as a supposed lacertilian form, *Paleoscincus,* that had the teeth only been found they would undoubtedly have been referred to that genus. It is possible that *Stegopelta* may eventually prove to be a *Paleoscincus* form. This, however, is hardly probable, on account of the great interval of time separating the strata which have yielded the two specimens, *Paleoscincus* occurring as it does near the top of the Fort Pierre Cretaceous and *Stegopelta* near the top of the Fort Benton. Were the form one of a stable group this might not be sound reasoning, but in a group of animals which evolved so rapidly as did the dinosaurs one would hardly expect a genus to continue for so long a time. At all events, the name *Stegopelta* may be retained until more evidence is forthcoming concerning *Paleoscincus*. If, as Hatcher believed (*23*), Lambe's *Stereocephalus* is a *Paleoscincus* form, then *Stegopelta* is a good genus, since it shows wide structural differences from the form which Lambe has described. The tooth which Lambe (*7*) has figured on page 57 certainly resembles those of *Paleoscincus,* and if the tooth really is to be associated with the remains described as *Stereocephalus* a question might arise as to whether these remains were not in reality portions of the skeleton of *Paleoscincus* as Hatcher intimated. Lambe (*8*) says the tooth provisionally associated with the *Stereocephalus* remains "differs from those of the Red Deer river district, referred to the two species of *Paleoscincus,* and is about twice as large as those of *P. costatus.*" Just how it differs he does not say, and one is at a loss in attempting to separate the forms from his figures. Size alone is usually no safe criterion for the separation of animal forms, and more particularly genera. I

can but agree with Hatcher that the tooth figured as *Stereocephalus* resembles the teeth of *Paleoscincus*.

The *vertebral column* is represented by posterior dorsal vertebræ, portions of the sacrum and two caudal vertebræ. The remains are more or less fragmentary, but enough is preserved to give a fairly accurate idea of this portion of the animal's anatomy, although it is impossible to determine the vertebral formula.

The *dorsal vertebræ* (plate LVIII, figs. 5 and 6) obtained are twelve in number, for the most part imperfectly preserved. They are cylindroid in form, very slightly amphicœlous, nearly amphiplatyan, and the arches are elevated as in *Stegosaurus* and *Polacanthus*. The centra are slightly excavated below the base of the neural arch as in *Scelidosaurus*. The neural canal is small and is wider in the ventral than in the dorsal portion. The centra measure 60 mm. in width by 70 mm. in length.

The *sacrum* (plate LIX, figs. 6 and 7) as preserved consists of two sections. One includes three firmly coössified vertebræ of the posterior end and the other a part of the anterior end representing two vertebræ. The anterior section measures 120 mm. in length by 70 mm. in width at the widest part. The fragment is very smooth and of a dense bony texture. The neural canal is broad posteriorly but narrows somewhat anteriorly. In plate LIX, figure 2, is represented a cross section through this fragment to show the sacral enlargement at the posterior end. The portion representing the posterior end of the sacrum (plate LIX, figure 7) measures 203 mm. in length by 64 mm. in width at the caudal end. The texture of this part is very fine and compact externally, but internally there is a tendency to a cancellated structure. An interesting characteristic of this element of the skeleton is the high degree of coössification of the various elements composing it. There is not the slightest indication of a suture where the different vertebræ have become joined so that the sacral centra are constituted in a solid bony rod tapering somewhat at the anterior end, as do the sacra of *Polacanthus* (*9*) and *Hylæosaurus* (*10*). The attachments for the sacral ribs are large, and are placed about midway dorso-ventrally of the centra of the sacrum. While the sacrum of *Stegopelta* resembles in a great measure that of *Polacanthus*, yet it varies from it in that the elements composing it are more highly coössified. This condi-

tion cannot be entirely attributed to the age of the individual but is expressive rather of the higher specialization of the present form.

Attached to the neural spines of the sacral elements was a long, narrow dermal plate (plate LVI, fig. 3), evidently in firm union with them. This plate occupied the mid-dorsal line of the great pelvic shield and lay between the iliac armor of the two sides. The plate, like all the rest of the dermal skeleton, is scrobiculate and somewhat of the texture of woven cloth, as Marsh has described in *Nodosaurus textilis* (*11*). It becomes slightly expanded posteriorly, where it measures 30 mm. in width.

The *caudal vertebræ* (plate LIX, fig. 1, and plate LVIII, fig. 3) vary to a remarkable degree from those of the dorsal series. They are greatly compressed dorso-ventrally; are very short, with the sides much rounded and the centra plano-convex. The vertebræ have strong transverse processes. In neither specimen is the neural spine preserved, so it is impossible to say as to its extent. This, however, may be inferred to have been low and stout, if one may judge from its broken bases. The neural canal is not large, measuring only 14 mm. in diameter. The centra measure 82 mm. in width by 38 mm. in length by 41 mm. in height. It is thus seen that the caudal vertebræ are more than twice as wide as long. This condition is not a unique one, since Hulke (*12*) has described the same condition in *Polacanthus*.

The *ribs* are all so fragmentary that no discussion of them can be given. Many of the fragments are triangular in cross section, agreeing in this respect with other armored dinosaurs. Attached to some of the rib fragments are found small bony scutes. The fact is of service in determining the position of these dermal scutes on the body of the animal.

The *ulna* (plate LIX, figs. 8 and 9) of the left side is preserved complete. It shows considerable variation from anything hitherto described for any other armored dinosaur. The shaft of the bone is flattened from side to side and is twisted from right to left. It ends in a rather pronounced expansion distally. The coronoid process is quite prominent and is excavated to form a large sigmoid cavity. The olecranon is long, measuring 70 mm. in length from the base of the coronoid process to the proximal end of the bone. It is flattened from

side to side and ends rather broadly, not in a point as does the ulna of *Stegosaurus*. Viewed from in front the ulna curves strongly outward, especially toward the distal end. It is not so straight as in *Stegosaurus*. The articular surface for the humerus is small. The radial articulations are, however, well marked, with the upper one forming a distinct fossa below the coronoid process. The lower articular surface of the ulna is well rounded and is oval in outline. The ulna measures 385 mm. in total length, 106 mm. antero-posteriorly at the widest part, 45 mm. near the middle of the bone and 60 mm. at the proximal end.

The *radius* is represented by fragments only. The head of one of the elements is nearly circular in outline and measures 60 mm. in cross section. The articular surface is so abraded that it is impossible to determine its form.

The *ilia* (plate LV) are both represented in the collection. The left one is preserved nearly entire. Enough is present to determine the total length and breadth of the bone, and the missing parts have been restored, as is evident from the photograph. The portion of the right ilium preserved shows the acetabulum. The description of the ilium will, however, be confined to that of the left side. The bone is elongate and slightly convex upwards; the convexity becoming strongly pronounced on the outer side. It is 50 mm. thick at the acetabulum, but thins to 5 mm. on the inner side and at the anterior end. The thinning is gradual in these two directions. On the outer edge, however, the bone remains thick for over three-fourths of its length, when it gradually thins, but not so much as on the inner edge. The entire dorsal surface of the ilium is covered by a mosaic of thick, bony, scrobiculate plates firmly united to it. These plates are more or less pentagonal in shape and are not all of the same size. On nearly all there occurs, on some in the center, on others near the edge of the plate, a pit, which in life may have supported a more or less elongate horny spine. When the pit is central it is located in the top of the central eminence which occurs on all of the plates. The plates were once, apparently, suturally connected, but there is now no indication of a suture. They form one continuous bony mass over the entire dorsal surface of the ilium. The diameter of the individual plates varies from 56 mm. to 105

mm., and they are all from 5 mm. to 15 mm. in thickness. A single plate is shown natural size in plate LVI, figure 8.

The lower surface of the ilium is nearly smooth. The only irregularities are the acetabulum and small ridges for muscular attachments. It is gently concave, the concavity becoming stronger towards the outer edge. The acetabulum is in the shape of an elongate oval and is defined by a high ridge of bone. The acetabular cavity is rather shallow and is deeper anteriorly than posteriorly. Its length is 190 mm. and the width, as preserved, is 82 mm. It may have had a somewhat greater width, but not to exceed 90 mm. at the most. The entire ilium measures 48½ inches in total length, 10½ inches at the widest part, and 8½ inches near the middle of the bone.

The ilium must have had a horizontal position during life, for the position of the acetabulum is such that the femur could not have articulated in it had the bone been in any other position. This condition is not exceptional among dinosaurs, since the ilia of *Polacanthus* had a similar position and the ilia of *Triceratops* are horizontal to a much less extent. The articular surfaces for the pubes and ischia have been broken away and lost, so it is impossible to determine the relations of these elements. However, they must have had much the same relations as Seeley (*13*), Lydekker (*17*) and Hulke (*14*) have described for *Polacanthus*.

The *pubes* (plate LVIII, figures 1 and 2) are both represented, the right one nearly complete but lacking the entire post-pubic process. This element resembles more nearly that of *Claosaurus* (*15*) than it does that of its nearest allies, *Polacanthus* (*13*) and *Stegosaurus* (*16*). In form the bone is elongate, flattened and spatulate. It curves gently inwards and is only slightly twisted. In thickness the pubis is nearly uniform, becoming thickened proximally to support the pectineal process (ectopubis of Baur). The pubis measures 300 mm. exclusive of the pectineal process, which is 57 mm. in length. In width the bone measures 112 mm. at the widest part and 86 mm. at the distal end. The external surface of the pubis is crossed by a diagonal ridge for muscular attachments. The post-pubis is not represented in the collection save by a fragment which may represent the disal end. The place where the process has been broken from the pubis is large, so the post-pubis may have been of some extent,

The *tibia* (plate LVIII, figure 4) is represented by the lower end of the bone belonging to the right side. Firmly coössified with it is the astragalus, which rises into a rather prominent ascending process on the anterior surface. The union of the astragalus with the tibia is so complete that were one to view the specimen from the posterior side its presence would never be suspected. On turning the bone over, however, the astragalus is distinctly seen, as is shown in the figure. The spine of the astragalus is broken off, but judging from the groove for its reception it must have been nearly 80 mm. in length. It measures 50 mm. in width at the base. The tibia measures 145 mm. in width distally. The articular surface is broad and pulley-shaped. There is a broad, shallow, trochlear groove which is bounded by two rounded projections. The groove runs up prominently on the posterior surface of the bone but is not so prominent on the anterior surface. From the narrowness of the broken surface of the bone, only 50 mm. in diameter, one would judge that the shaft of the tibia was very slender as described by Hulke (*18*) in *Hylæosaurus* and in *Polacanthus* (*19*). It resembles these forms also in that the shaft of the tibia is triangular in cross section, forming in this case a nearly isosceles triangle. The section shows a marked difference between the exterior of the bone, which is smooth and compact, and the interior, which is coarsely cancellated.

The *fibula* (plate LIX, figures 4 and 5) is represented by the proximal and distal portions of the bone belonging to the right side. The proximal end, which is subtriangular in cross section, measures 85 mm. in width and is considerably expanded as compared to the shaft. The upper end is so weathered that no traces of the rugose surface for the attachment to the tibia are left. However, one side is flattened as if for such a union. The external side of the head is marked by a rather prominent condyle, which projects some 5 mm. from the surface. The shaft of the bone is very slender. At a distance of five inches from its upper end the fibula measures 20 mm. by 30 mm. in diameter being thicker antero-posteriorly than from side to side. In structure the fibula is much like that of the tibia, already described. The distal end, also, triangular in cross section, is of the same proportions as the proximal end.

The *metatarsals* (plate LVIII, figure 7) are represented by

several fragments. The proximal and distal ends of one of them are preserved so that a reconstruction is possible. These fragments represent a rather elongate, slender element with the upper surface rounded and the lower surface somewhat flattened. The proximal articular surface is widely concave and the distal end is pulley-shaped. It is thus evident that the metatarsal is not different from that of other herbivorous dinosaurs. The length of the bone as restored is 150 mm., the breadth of the proximal end is 80 mm., and the height 60 mm.

The *dermal armor* consists of small bony scutes, large dermal spines and heavy plates, all of various shapes and sizes. Mingled in with the other bones of the skeleton were more than four score small bony scutes (plate LVII), varying in diameter from 15 to 75 mm. and of various thicknesses from 4 to 20 mm. The scutes are all scrobiculate and are for the most part rounded, though some are elongated, one scute before me measuring 60 mm. in length by 30 mm. in breadth. The majority of them possess a ridge asymmetrically placed, which runs nearly the entire length of the scute. Others run up to a point in the center; others are flat.

In structure all of the scutes are of a coarsely cancellated character, such as Hulke has described for the scutes occurring in *Polacanthus*. Associated with them were many fragments of heavy triangular ribs with which some of the scutes were firmly united. From this fact it would appear probable that the scutes were scattered along the back of the animal anterior to the great pelvic shield. The elongated scutes referred to above may possibly have been situated on the neural spines of the vertebræ, as in *Scelidosaurus* (*20*). The larger scutes, some of which are as large as the palm of one's hand, were very probably located near and anterior to the great pelvic shield.

Scutes very similar to these described for *Stegopelta* are found in a number of different armored dinosaurs as well as among the crocodiles. There are really no structural differences between the scutes of *Stegopelta* herein described and those found in the common Mississippi alligators. The pittings on the *Stegopelta* scutes are, however, smaller than in the latter. Hulke (*21*) has described a few scutes belonging to *Polacanthus* which resemble the present specimens very much. Lambe (*22*) has figured three scutes associated with the form *Stereo-*

*cephalus* which are almost identical with the scutes of *Stegopelta.* Hatcher (*23*) was certainly in error in criticizing Lambe's association of these scutes with dinosaurian remains and in claiming that they were of a crocodilian nature, since in the present specimen there can be no doubt as to their dinosaurian character. Nopsca (*24*) has also fallen into the same error as did Hatcher when he says that crocodilian remains were associated with the *Polacanthus* specimen. Seeley (*25*) has described and figured scutes similar to the above in *Crateomus.* Huxley (*26*) has described and figured identical scutes in *Acanthopholis.* Marsh (*27*) has figured some small bony scutes in *Triceratops.* Owen has figured scutes of a like nature in *Scelidosaurus* (*20*). Possibly other armored dinosaurs possessed such scutes.

The question of the morphological value of these scutes is an interesting one. Judging from the scutes in *Stegopelta,* one would incline to the opinion that they represent the rudiments of a complete bony armor which in time, had the dinosaurs survived, might have covered the whole dorsum of *Stegopelta's* descendants. Such a suggestion might apply equally well to our modern crocodiles. It is pretty certain that the scutes in the crocodiles are not vestigial, since it is not now conceded that the modern Crocodilia are descended from the ancient armored teleosaurs (*28*).

The *dermal spines* (plate LVI, fig. 1, plate LIX, fig. 3) are all of a dense bony texture with the external surface pitted. A portion of a small dermal spine is represented, natural size, in plate LIX, fig. 3. Its base is broken away so it is impossible to determine its extent, but this was, in all probability, not considerable. One of the most peculiar portions of the dermal armor is that represented in plate LVI, fig. 1, which is called a large dermal spine, and which I have provisionally located near the base of the tail. The spine is asymmetrical and is lateral in position, having had a mate on the opposite side of which nothing remains.

The spine preserved is much broken and the distal tip is lost. As reconstructed it is of massive proportions in comparison to the rest of the exoskeleton. In cross section it is for the most part triangular, with two sides of the triangle concave and one convex. It is rounded near the distal end. The spine, unlike most elements of a similar nature, is bifid, as is represented in the figure (plate LVI, fig. 1). The short

spine measures 80 mm. from the point of its inception to the tip, and the main spine measures 16 inches from tip to tip. At its widest part it is 100 mm. in breadth. The surface of the bone is pitted with irregularly placed cavities as though it were encased with horny substance.

The exact position of this large spine on the body of the animal is, of course, largely a matter of conjecture, since it was found broken and disassociated and mingled with various other parts of the skeleton, but it seems best to locate it back of the pelvic shield, since the caudal vertebræ are much stouter than the dorsal ones and since there is no evidence of any armor excepting the small bony scutes anterior to the pelvis. The spine is totally unlike anything described for any other stegosaurian dinosaur.

The *dermal plates*, represented in plate LVI, figs. 2 and 9, are massive and of a compact texture. Their position on the skeleton is a puzzle. The plate represented in plate LVI, fig. 9, is not entire. It is asymmetrical, one side being crossed by a rather high ridge. Its upper surface has pittings and grooves. The under surface is smooth and rounded. It is possible that this is a portion of another girdle similar to the one described below. That it is not a part of that girdle is evident from its proportions. The plate measures 105 mm. in diameter. The other dermal plate (plate LVI, fig. 2) is apparently complete, with a broad surface for articulation with some element which is now lost. This plate is concavo-convex. It measures 140 mm. across in the longest diameter. It is without vascular markings of any kind, but is smooth as though it were entirely embedded in the flesh of the animal.

The part of the *girdle* represented in plate LVI, figs. 6 and 7, is like the last described plate in that it is of a compact texture. In the girdle the upper surface is pitted, and crossed at regular intervals by rather high ridges the sides of which are slightly concave. This bone at once reminds one of the similar element figured and described by Lambe (*29*) as occurring in the *Stereocephalus* form. Lambe (*29*) however, located the girdle back of the head, and if his interpretation of the large fragment which he calls the skull is correct such a location would be quite plausible. The present girdle differs in a great degree from that described by Lambe, since it is asymmetrical and had a mate on the opposite side, of which there are fragments in the collection. It differs further in being a solid mass

of bone instead of a bony ring to which the scutes are united. The girdle as preserved is in the form of an arch and is composed of three plates, only two of which are ridged. The under surface is smooth and longitudinally convex. The part of the girdle preserved measures 320 mm. in length and 110 mm. in width.

*Stegopelta* finds its nearest allies in *Polacanthus,* from the Wealden of the Isle of Wight; in *Paleoscincus,* which must, I think, include the *Stereocephalus* of Lambe, from the Belly river deposits; and *Stegosaurus,* from the Lower Cretaceous of Wyoming and Colorado. The characters which separate *Stegopelta* from *Stegosaurus* and *Paleoscincus* have already been considered. From *Polacanthus* the present form differs in the whole surface of the ilium being covered in the former animal with a firm mosaic of very small, somewhat rounded, plates, which are scarcely at all sculptured, as I learn from Doctor Williston, who has examined the type specimen. These plates in *Stegopelta* are relatively quite large and strongly sculptured. The present form differs from *Polacanthus* also in the divergence of the points of the ilium anteriorly. In *Polacanthus* the iliac region was entirely covered by a bony shield, but in *Stegopelta* this shield was not continuous, but there was a space between the anterior ends of the ilia which was filled, probably, with small bony scutes. There have been many stegosaurian dinosaurs described from various parts of the world, notably North America and Europe. The group seems to have had a very wide distribution geographically.

In conclusion, I wish to express my gratitude to Dr. S. W. Williston, not only for his kindness in turning over the material to me for description but for his kindly interest and help during the entire investigation.

The specimen is in the Walker Museum, University of Chicago.

---

Since the above was written there have appeared two papers describing two new types of dinosaurian reptiles closely allied to the above-described form. One of these papers,* from the American Museum of Natural History, is of especial interest, since the material supplements in an excellent way that which has just been described. Mr. Brown's restoration of the *Ankylosaurus magniventris,* while based in large part on Marsh's

* Brown, Barnum, 1908. Bulletin Amer. Mus. of Nat. Hist., vol. XXIV, p. 187.

drawing of *Stegosaurus ungulatus,* is not accurate as to the form of the animal. The pelvic region was undoubtedly covered over with a heavy shield as in *Stegopelta.* Indeed, Doctor Williston† says, "*Ankylosaurus* is either very closely allied to or identical with *Stegopelta* Williston, a genus overlooked by Mr. Brown."

The remains described by Mr. Brown consisted of a skull, some small dermal scutes, a few vertebræ, a scapula, a few ribs and other parts, most of which were lacking in the above-described animal.

Dr. O. Abel has given (Verhandl. d. k. k. Zoöl.-bot. Gesell. in Wien, Bd. LVIII, p. 215, fig. 3) a restoration of *Ankylosaurus magniventris* Brown. It is to be doubted if he has added to our knowledge of dinosaurian attitudes, since the reader is at once struck with the grotesque and impossible attitude which he has caused the animal to assume. It is unfortunate that Brown's ideas of the arrangement of the scutes on the back should have been given by Doctor Abel, since there is not the slightest evidence that they assumed anything like the arrangement he has represented.

The other dinosaur is from the Niobrara Cretaceous of Kansas and was collected by Mr. Charles Sternberg in the Hackberry creek region.

Doctor Wieland‡ describes these remains as *Hierosaurus sternbergii,* new genus and species. This form is also doubtfully distinct from *Stegopelta,* unless it be that the skeletal characters were widely at variance to the characters of the dermal plates. A comparison of figure 9, plate LVI, of the present essay, with Doctor Wieland's figure 6, will show how very closely the dermal elements of the animals resemble each other. Comparisons also of the figures on plate LVII of the present paper with Doctor Wieland's figures 2, 4 and 5 will reveal the close similarity of the small dermal elements. It would, however, be too previous to say certainly that *Hierosaurus* and *Stegopelta* are identical. The geological horizon of the two specimens is certainly not far apart, or perhaps identical, since the Hailey shales occupy relatively the same position in Wyoming as the Niobrara chalk does in Kansas.

† American Naturalist, vol. XLII, No. 501, p. 629.

‡ Wieland, G. R., 1909. Amer. Jour. Sci., March, p. 250.

## BIBLIOGRAPHY.

1. WILLISTON, S. W. A New Armored Dinosaur from the Upper Cretaceous of Wyoming. Science, N. S., vol. XXII, No. 564, Oct. 20, 1905, p. 503.
2. News item, SCIENCE, N. S., vol. XXIV, No. 622, Nov. 30, 1906, p. 711.
3. DARTON, N. H. Geology of the Owl Creek Mountains. Senate document No. 219. Washington, D. C., 1906. Page 22.
4. LEIDY, JOSEPH. Notice of Remains of Extinct Reptiles and Fishes Discovered by Dr. F. V. Hayden in the Bad Lands of the Judith River, Nebraska Territory. Proc. Acad. Nat'l Sci., Phila., vol. VIII, pp. 72-73.
5. LEIDY, JOSEPH. Extinct Vertebrata from the Judith River and Great Lignite Formations of Nebraska. Trans. Amer. Philos. Soc., vol. XI, pp. 139-154, with plates VIII-XI. 1860.
6. DARTON, N. H. Geology of the Big Horn Mountains. Professional Paper No. 51, p. 55. Washington, D. C. 1906.
7. LAMBE, L. M. Contributions to Canadian Paleontology, vol. III, pt. II: On Vertebrata of the Mid-Cretaceous of the Northwest Territory. Art. No. 2: New Genera and Species from the Belly River Series. Geological Survey of Canada. 1902.
8. Contribution to Canadian Paleontology, vol. III, p. 57.
9. HULKE, J. W. Phil. Trans., 1881, p. 654, pl. 71, fig. 1.
10. OWEN, RICHARD. Monograph of the Fossil Reptilia of the Wealden Formation. Paleontographical Society, 1857, pl. V.
11. MARSH, O. C. The Dinosaurs of North America. 16th Ann. Rep. U. S. G. S., 1896, pl. LXXV, fig. 5.
12. HULKE, J. W. Phil. Trans., 1881, p. 655.
13. SEELEY, H. G. On the Os Pubis of Polacanthus foxii. Quart. Jour. Geol. Soc., vol. 48, pp. 81-95, pl. I.
14. HULKE, J. W. Phil. Trans., 1887, p. 171, pls. 8 and 9.
15. MARSH. Dinosaurs of N. A., 1896, pl. LXXIX, fig. 5.
16. Ibid, fig. 6.
17. LYDEKKER, RICHARD. On Part of the Pelvis of Polacanthus. Q. J. G. S., vol. XLVIII, pp. 148-149, with 2 figures.
18. HULKE, J. W. Q. J. G. S., vol. 30, pp. 516-518, pl. XXXI, figs. 1, 2.
19. HULKE. Phil. Trans., 1881, p. 657.
20. RICHARD OWEN. Monograph on Scelidosaurus, pt. II, Paleontographical Society, 1862, p. 20, pl. IX.
21. HULKE. 1881. Phil. Trans., p. 657, pl. 75, figs. 5, 6.
22. LAMBE. 1902. Contribution to Canadian Paleontology, vol. III, p. 56, pl. XXI, figs. 6, 7, 8.

23. HATCHER, J. B. 1905. Vertebrate Fauna of the Judith River Beds. Bull. U. S. G. S., pp. 67-103.

24. NOPSCA. 1905. Geol. Mag., N. S., Dec. 5, vol. II, p. 241.

25. SEELEY. 1881. Q. J. G. S., p. 653, pl. 31, fig. 3.

26. HUXLEY. 1867. Geol. Mag., vol. IV, p. 66, pl. V.

27. MARSH. 1896. Dinosaurs of North America, pl. LXX.

28. WILLISTON, S. W. American Amphicœlian Crocodiles, Jour. Geol., vol. XIV, No. 1, p. 1, 1906.

29. LAMBE. Contribution to Canadian Paleontology, vol. III, p. 56, pl. XII, figs. 3, 4, 1902.